

## REMARKS

The Examiner is thanked for the Office Action of March 30, 2007. This request for reconsideration is intended to be fully responsive thereto.

## AMENDMENTS TO CLAIMS

Claim 1 was amended to mainly clarify the limitations and differences from the cited reference. Additional phrase, "...said primary system transmits information...and deletion causing a data modification within the block" is supported by the paragraph [0049]. Another additional phrase, "...said accelerator system has a communication mechanism receiving modification information...the primary block or overflow block in the primary system" is supported for example by the paragraphs [0093], [0104], [0189], [0191]-[0193], [0087], and [0013]. No new matter has been added.

Claims 2-7 and 9-12 were canceled. Claim 8 was amended to mainly clarify the limitations and differences from the cited reference. Additional phrase "...said primary system transmits information...and deletion causing a data modification within the block" is supported by the paragraph [0050]. Another additional phrase, "...said accelerator system has a communication mechanism receiving modification information...the alternative-key block in the primary system" is supported by such as the paragraphs [0093], [0120]-[0122]. No new matter has been added.

## REJECTIONS UNDER 35 U.S.C. 102 (b) BY TAMATSU

Claims 1, 6, 8, and 12 were rejected under 35 USC 103(a) as being unpatentable by US Patent Publication No. 2001/0011321A1 to Tamatsu (Tamatsu) further in view of US Patent Publication No. 2003/0158842A1 to Levy et al. (Levy).

Regarding Claim 1, the Examiner stated that Tamatsu disclose all elements

except for the primary system; however, Levy teach a system comprises primary system. Please be noted that Claim 1 was amended to clearly distinguish the present invention from the cited references. The amended Claim 1 reads:

Claim 1: A computer readable medium containing a database accelerator, comprising:

a primary system that holds data records having data items including primary keys, primary blocks that store the data records in the order of their primary keys, and a location table that contains in a contiguous region location table entries containing the addresses of the primary blocks, said primary system transmits modification information of a location of any modification in the location table and a content of modification to any accelerator connected to the primary system when any modification occurs to the location table due to data addition, update, and deletion causing a data modification within the block;

~~a frond location table having frond location table entries in a contiguous region indicating the blocks identical to the location table entries of each primary block; and~~

~~an accelerator system the frond location table entries are updated synchronously or asynchronously according to the updated information issued by the primary system when the location table entry of the primary blocks is updated~~ that has a frond location table holding frond location table entries in a contiguous region indicating the blocks identical to the location table entries of each primary

block,

said accelerator system has a communication mechanism receiving modification information from the primary system when any modification occurs to the location table due to data addition, update, and deletion causing data modification within the block while transmitting information for completing the application of the modification information to the primary system when the modification is completed and a modification information application mechanism performing necessary updating on the basis of modification information transmitted from the primary system, and retrieval by means of the primary key on said accelerator system is such that a binary search is performed using the frond location table of the accelerator system to retrieve the frond location table entries with a target key value to determine an object block and that retrieval relative to the record within the block is performed relative to the primary block or overflow block in the primary system..

Neither Tamatsu or Levy disclose or teach the currently added limitations regarding the primary system transmitting the information of the location of the modification in the location table and the content of the modification to the accelerator system when the modification occurs to the location table due to data addition, update, and deletion causing the data modification within the block. Neither Tamatsu or Levy disclose or teach the currently added limitations regarding the characteristics of the communication mechanism and modification information application mechanism and more. Therefore, Tamatsu in combination with Levy should not be good references to reject the amended

Claim 1.

By the amendments, Claims 8 and 12 were canceled. Regarding Claim 8, the Examiner stated that Tamatsu discloses all elements except for the primary system; however, Levy teach a system comprises primary system. Please be noted that Claim 8 was amended to clearly distinguish the present invention from the cited references. The amended Claim 8 reads:

Claim 8: A computer readable medium containing a database accelerator, comprising:

a primary system that holds data having data items including primary keys and alternate keys, primary blocks that store the data records in the order of their primary keys, alternate-key blocks that stores the alternate-key entries made up of alternate keys and primary keys in the alternate-key value order, and alternate-key location table that contains the alternate-key location table entry in a contiguous region, said primary system transmits modification information of a location of any modification in the alternate-key location table such as alternate-key location table entry number and a content of modification to any accelerator connected to the primary system accelerator system when the alternate-key location table is modified as the alternate-key entry within the alternate-key block is modified in the case that alternate-key modification occurs due to data addition, update, and deletion causing a data modification within the block; and

an accelerator system that holds a frond alternate-key location table

that contains the frond alternate-key location table entries indicating alternate-key location table entries of each alternate-key block and the identical alternate-key block in the contiguous region, where said alternate-key frond location table entries, when the alternate-key location table entry of each alternate-key block is updated, is synchronously or asynchronously updated based on the newly updated information sent from the primary system and has a communication mechanism receiving modification information from the primary system when any modification occurs to the alternate-key location table due to data addition, update, and deletion causing data modification within the alternate-key block while transmitting information for completing the application of the modification information to the primary system when the modification is completed and a modification information application mechanism performing necessary updating on the basis of modification information transmitted from the primary system, and retrieval by means of the alternate-key on said accelerator system is such that a binary search is performed using the frond alternate-key location table of the accelerator system to retrieve the frond alternate-key location table entries with a target key value to determine an object alternate-key block and that retrieval relative to the record within the alternate-key block is performed relative to the alternate-key block in the primary system

For the same reason as stated above in the discussion of the amended Claim 1, the

amended Claim 8 should be different from the cited references.

### ADDITIONAL INFORMATION

Conventionally, in the recent computer systems, dividing server functions can only lessen the load on the logic part, not the database system, which creates the problem of slowing down the process. One technique in the prior art for the improvement of scalability is the load balancer. This consists of deploying multiple servers that appear to be a single server. At high levels of external processing requests, processing requests first go to the load balancer and scalability is achieved with the allocation by the load balancer of processing requests among the multiple servers thus alleviating the processing load per server. However, this approach suffers from a fatal shortcoming. This is that since multiple servers are capable of processing only the logic of the processing and since a database is a singularity and each server accesses the same database, database performance has been restricted by processing performance. In other words, even if servers are added for increases in processing requests, database performance reaches an upper limit.

The present invention was made to deal with this problem. The Applicant realized that the number of data record access is less than that of the index access. Given one billion data records, there will be fifty million blocks if an average of twenty records may be stored in a block. If there are no overflow blocks, the number of location table entries will be fifty million. Binary searches will be performed on this location table to retrieve object blocks, and the number of binary search iterations will be a log value with a base of 2. This gives a value of 25.6 iterations, which rounds up to within 26 iterations.

This applies likewise to retrieval by alternate key. The recitation of the present

invention assumes the use of alternate-key tables in a form that employs alternate-key location tables. Retrieval by alternate key is performed by performing binary searches on alternate-key location tables. Assume that alternate-key blocks maintain an average of fifty entries. The number of alternate-key blocks will be twenty million. In other words, the number of alternate-key table entries will be twenty million. Binary searches will be performed on these alternate-key tables. The number of binary search iterations will be 24.3, which rounds up to within 25 iterations.

On the other hand, the expected value of searches for a record within a block, without using special methods and reading from the first record, is ten. If binary searching may be employed, the value is within five iterations.

Based on the above-fact, the present invention prepares multiple copies of the location table and alternate-key location table corresponding to the index of the conventional database system and performs parallel access to these in order to achieve the overall process ability. This shows that the volume of data processed may be increased by deploying multiple location tables and alternate-key location tables, copying their most recent entries and alternate-key entries, increasing the number of paths permitting key retrieval and allocating a CPU to each path.

In the conventional database system, the index structure is extremely complex, and the concept of holding multiple copies thereof was not existing. Conventional index has a hierarchical structure, and data addition, modification, and deletion require index modification, which may require modification of the higher layer of index. However, the location table and the alternate-key location table have a flat structure, which does not require modification for data addition, modification, and deletion, which allows multiple copies.

The primary system modifies the data within the block due to the data addition,

modification, and deletion, and has the function to transmit the location of the location table modification (location table entry number) and the content of the modification from the primary system to the accelerator system when the location table is modified. Also, the primary system transmits modification information of a location of any modification in the alternate-key location table such as alternate-key location table entry number and a content of modification to an accelerator system when alternate-key location table is modified as the alternate-key entry within the alternate-key block is modified in the case that alternate-key modification occurs due to data addition, update, and deletion causing a data modification within the block.

When the addition, update or deletion of data on the primary system results in the rewriting of data in blocks and this entails modification of the location table, the primary system transmits to the accelerator system the locations modified in the location table (the numbers of the location table entries) and the substance of those modifications, and the accelerator system updates those location table entries.

Likewise, when the addition, update or deletion of data on the primary system results in the rewriting of data in blocks and this entails modification of an alternate key, and when alternate-key entries in alternate-key blocks are rewritten and this entails updating of an alternate-key location table, the primary system transmits to the accelerator system the locations modified in the alternate-key location table (the numbers of the alternate-key location table entries) and the substance of those modifications, and the accelerator system updates those alternate-key location table entries.

an accelerator system that has a frond location table holding frond location table entries in a contiguous region indicating the blocks identical to the location table entries of each primary block, said accelerator system has a communication mechanism



receiving modification information from the primary system when any modification occurs to the location table due to data addition, update, and deletion causing data modification within the block while transmitting modification information for completing the application of the modification information to the primary system when the modification information is completed and a modification information application mechanism performing necessary updating on the basis of modification information transmitted from the primary system, and retrieval by means of the primary key on said accelerator system is such that a binary search is performed using the frond location table of the accelerator system to retrieve the frond location table entries with a target key value to determine an object block and that retrieval relative to the record within the block is performed relative to the primary block or overflow block in the primary system.

FIG. 2 shows an example of a primary system and an accelerator system. An accelerator system is one that, of the functionality of the primary system, maintains the location table and alternate-key location tables in whole or in part and that has the functionality of synchronizing these tables with the primary system and the functionality of using these tables to retrieve blocks in which records are stored. An accelerator system does not hold blocks, and the location table entries on an accelerator system hold the addresses of blocks on the primary system. Likewise, alternate-key location table entries on an accelerator system contain the addresses of alternate-key blocks on the primary system.

The communications mechanism receives modification information from the primary system and, when the modification information has completed on the accelerator system, transmits information that application of the modification information has completed. The modification information application mechanism performs the necessary updating on the basis of modification information transmitted from the

primary system.

Explanation and description regarding the primary system can be seen in many paragraphs in the specification such as [0097], [0101], [0103], [0110], [0114], [0123], [0128], [0134], [0136], [0144], [0175], [0178], and [0182]. By adding the accelerator system to the primary system, accessing to the index can be dispersed, and theoretically the accelerator system can be added without limitation, which remarkably increases the overall database processability.

## CONCLUSION

It is respectfully submitted Claims 1 and 8 are now in condition for allowance and notice to that effect is respectfully requested. Should the Examiner believe further discussion regarding the above claim language would expedite prosecution they are invited to contact the undersigned at the number listed below.

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